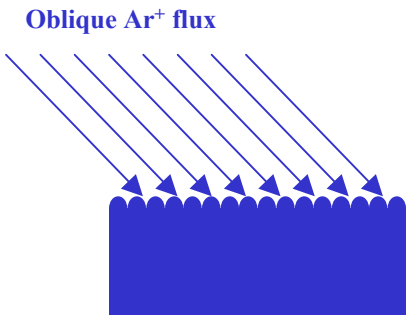
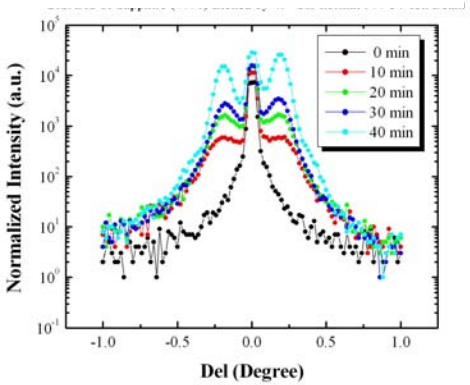
Development of a system for time-resolved studies of thin film growth and processing and student training.

Randall L. Headrick, University of Vermont

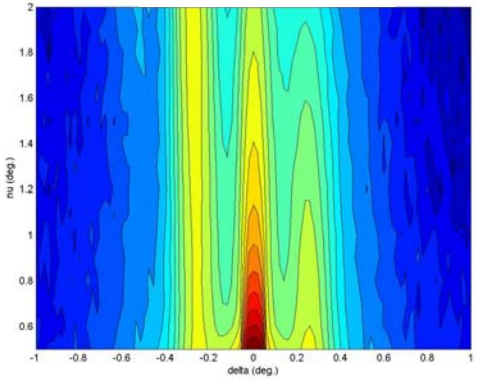
DMR-0216704



Time-resolved GISAXS

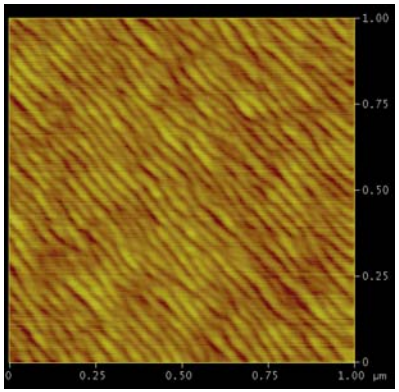


2D GISAXS



<u>In-*situ* GISAXS Study of the Formation of Tunable Nano-ripples on a Sapphire (0001) Surface by Ion etching</u> This award enabled the construction of an ultra-high vacuum thin film deposition system with in-situ x-ray scattering and Reflection High Energy Electron Diffraction (RHEED) capabilities. Tunable nano-ripples formed by energetic-bombardment-induced surface self-organization provides insights into the mechanisms of ion irradiation-induced evolution of surface morphology. Semiconductors and magnetic layers can also be patterned with the same method. Data were collected with the instrument at the National Synchrotron Light Source at Brookhaven National Laboratory, beamline X21.

AFM



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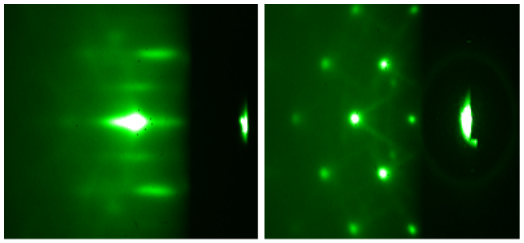
Reflection High Energy Electron Diffraction

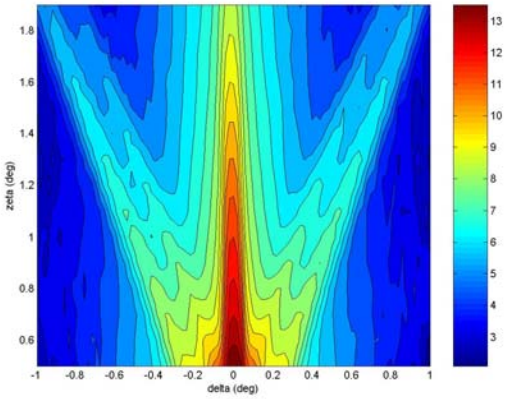


(a) (b)

(a) 2 × 1 Si surface before growing Ge

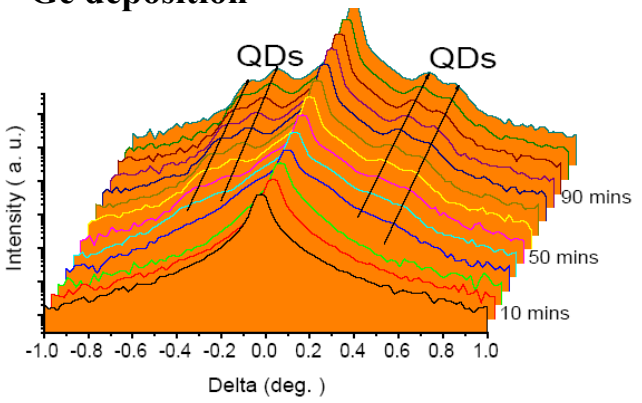
(b) Spotty Pattern of Ge QDs

2D GISAXS pattern from Ge QDs



Time-resolved GISAXS During Growth of Ge Quantum Dots on Si (001) This award enabled the construction of an ultra-high vacuum thin film deposition system with in-situ x-ray scattering and Reflection High Energy Electron Diffraction (RHEED) capabilities. Self-assembled Ge quantum dots (QDs) form spontaneously as a means of relieving the strain caused by the mismatch between the larger Ge lattice and the smaller lattice of the Si substrate. In-situ time-resolved GISAXS (Grazing Incidence Small Angle X-ray Scattering) is a powerful tool to monitor the formation of QDs. Data were collected with the instrument at the National Synchrotron Light Source at Brookhaven National Laboratory, beamline X21.

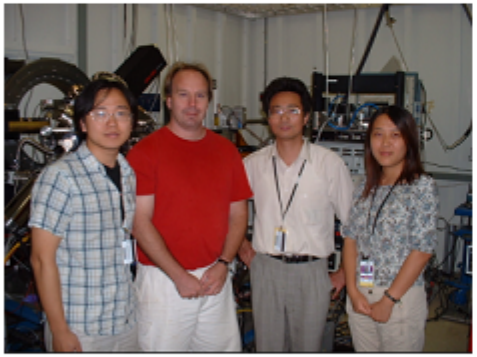
Time-resolved GISAXS during Ge deposition



Time-resolved GISAXS During Growing Ge Quantum Dots on Si (001)

Zhangcheng Xu, Randall Headrick, Hua Zhou and Lan Zhou
Department of Physics, University of Vermont, Burlington, 05401, USA
September 1, 2004

Self-assembled Ge quantum dots (QDs) form spontaneously as a means of relieving the strain caused by the mismatch between the larger Ge lattice and the smaller lattice of the Si substrate. Time-resolved GISAXS (Grazing Incidence Small Angle X-ray Scattering) is a powerful tool to monitor the formation of QDs.

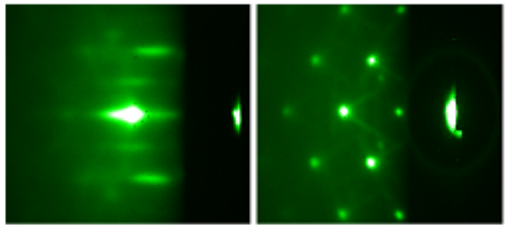


Group members:

Randall Headrick (Left 2), Ph. D., Assistant Professor
Zhangcheng Xu (Right 2), Dr. Eng., Ph. D., Post-doc Associate
Hua Zhou (Left 1), BSc., Graduate Student
Lan Zhou (Right 1), MSc., Graduate Student

Prof. Randall Headrick, Dr. Zhangcheng Xu, and Mr. Hua Zhou are the three founders of our growth and etching facility.

Reflected High Energy Electron Diffraction



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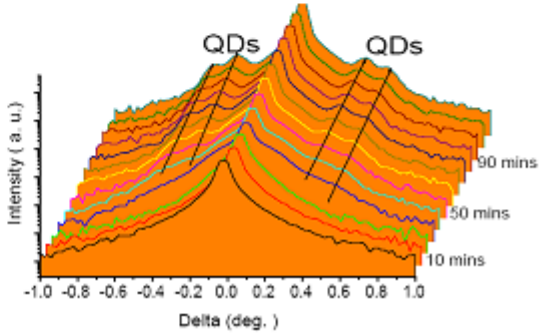
Time-resolved GISAXS



This project was sponsored by the U.S. Department of Energy